PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

ESCUELA DE POSGRADO

"Revisión sistemática de los métodos de evaluación de experiencia de usuario de sitios web informativos"

Trabajo de investigación para optar el grado académico de Magíster en Informática con mención en Ingeniería de Software

AUTOR

Ana Cecilia Ten Escalante

ASESOR

Freddy Alberto Paz Espinoza

JURADO

Jose Antonio Pow Sang Portillo

Freddy Alberto Paz Espinoza

Claudia Zapata Del Rio

LIMA – PERÚ

2017

Índice

Resumen del trabajo de tesis

El presente trabajo de tesis consiste en una revisión sistemática, presentada como artículo científico, sobre los métodos de evaluación que son empleados actualmente para la evaluación de la experiencia de usuario en sitios Web informativos. El trabajo de investigación consiste en una revisión de la literatura para identificar los métodos, criteros y herramientas empleadas para evaluar la experiencia de usuario en sitios web de acuerdo a la definición planteada para ambos términos en la ISO 9241. Las investigaciones consideradas para la revisión fueron encuestas, estudios de casos, estudios comparativos y experimentos que incluyan la descripción de la metodología aplicada. El artículo fue publicado en Springer como parte de la participación en el evento "HCI International 2017", realizado en Vancouver (Canadá) en el 2017.

A Systematic Review of User Experience Evaluation Methods in Information Driven Websites

Ana Cecilia Ten, Freddy Paz

Pontificia Universidad Católica del Perú, Lima, Perú

aten@pucp.edu.pe, fpaz@pucp.pe

Abstract. Information driven websites main goal is to provide updated and relevant content to the user according to business goals. Website's user experience evaluation differs from transactional web applications such as e-commerce, e-banking or travel because in addition to usability and accessibility; aesthetics, content, trust and persuasion must be considered for project success. However, since user experience is an emergent field with several frameworks and methods, it's necessary to evaluate which ones have been used previously. This paper presents the results of a systematic review aimed to identify the state of the art in methods, tools and criteria used to evaluate the user experience in information driven websites.

Keywords: user experience, usability, website, method, systematic review

1 Introduction

At present, most organizations in the public or private sector own one or more websites for communication purposes[1]. The main goal of these applications is to provide the user with access to updated and relevant content [2] about the products and services of the organization that owns the property. User profiles, communication goals and content structure can change depending on the industry[3]: government websites can be focused with giving to the general population an understanding about administrative process and legislation, higher education institutions can be focused in providing information about their academic programs and admissions, banking with promoting of a portfolio of services and so on.

Because information driven websites are publicly available and do not have necessarily a captive audience, usability and user experience are critical factors for user retention and in consequence, to the project success [4]. By contrast, other web applications such as e-commerce, e-banking or intranets have registered users that have already been convinced of using the service provided by the organization that owns the application. Information driven websites are usually in the early stages of the user/customer acquisition process[5]. This means that generic approaches for user experience or usability evaluation won't address the specific nuances that define success for web applications that are driven by information acquisition, brand representation, persuasion [6] and trust [7].

We understand usability and user experience by the following definitions, as specified in the ISO 9241 standard[8]:

- **Usability:** An extension in which a system, product or service can be used by specific users to achieve determined goals with effectiveness, efficiency and satisfaction in the defined context of use.
- **User Experience (UX):** Extends the concept of usability (effectiveness, efficiency and satisfaction) to the perception and responses resulting from the use and/or anticipated use of a product, system or service.

Because information driven websites are the sum of its parts (software, content, brand identity and visual design) they require to be evaluated at the user experience level including the following criteria: usability, content, navigation, aesthetics, performance, and the emotional response of the user after completing the task they wished to accomplish[9]. However, most of the times website development is treated as software project that addresses only the customization or creation of a Content Management System (CMS). CMS is a computer application that allows publishing, editing and modifying content, organizing, deleting as well as maintenance from a central interface [10]. This means both content and emotion can't be evaluated because they are aspects that are out of the bounds of the software development process. Because the extent and nature of the content defines the website's navigation[11] and the aesthetics of the visual design, this approach can lead to navigation issues and designs that are not suitable to the content they display, which in turn can result in usability issues because it's hard for the user to accomplish an information seeking task. This can lead to user frustration, and impact the user's perception of the brand, since he can translate the poor user experience he had while using the website as an attribute of the brand that owns it.

The systematic review presented in this paper seeks to recognize the state of the art in methods, tools and criteria used to evaluate user experience for information driven websites. The organization of this paper is as follows: section 2 details the process performed for the systematic review (criteria and process of selection of studies), section 3 shows the results obtained, and section 4 the conclusions and future work.

2 Systematic Review

The systematic review presented below was executed according to the parameters provided by Kitchenham and Charters [12]. The activities carried out for the implementation of the review were: definition of research questions, definition of the search chain and inclusion and exclusion criteria, selection of primary studies, data extraction, and synthesis of results.

2.1 Research Questions

For the definition of the research questions we used the PICOC technique (population, intervention, comparison, results and context:

Criteria	Value
Population	Websites and portals
Intervention	Methods, tools and criteria for usability and user experience evaluation
Result	Identify de efficiency and effectiveness of the methods and tools used to evaluate the usability and user experience from existing studies.
Context	Primary studies that present and evaluate the performance or new, existing or combination of existing methods, tools and criteria for the evaluation of usability and/or user experience in websites, microsites, portals and mobile websites. Studies must include the validation of the proposed methods at some level.

The defined research questions are:

- What methods and tools are used to evaluate user experience and usability in websites?
- Which criteria are considered for the evaluation of the different aspects of the user experience?

- At what stage of development does the evaluation apply?
- Efficiency and effectiveness: how satisfactory were the results obtained? How much did they cost in terms of time and resources?

2.2 Search Strategy

Search terms.
For the extraction of studies the criteria of population, intervention, result and context were considered.

- T1 = framework OR tool OR technique OR groundwork OR approach OR scheme OR plan
- T2 = user experience OR ux OR customer experience OR cx OR usability OR User centered design OR interaction design
- T3 = website OR websites OR site OR Web page

The databases used for the gathering of information are: Web of science, IEE y Scopus

2.3 Study Selection

Papers that fall in the following categories were included:

- Papers that present surveys, case studies or experiments of one or more methods or tools for the evaluation of usability or other aspects of user experience. The paper must include the description of the empirical validation process of the proposed method.
- Empirical studies that show comparisons between two or more methods/tools or combination of them.

Documents with the following characteristics were excluded:

- Tools and methods for mobile app usability/accessibility testing, since they are mostly focused in complex functionality/tasks.
- Articles that condense previous knowledge, collections of best practices and recommendations that are not applied to a specific case, reflections upon existing metrics or models.
- Tools and methods for usability/accessibility evaluation of web applications/websites which main goal is other than informative, for example, websites focused in ecommerce or eLearning.
- Methods focused only in the requirement generation process, since they do not validate the method results in the context of a real project.
- Studies focused only in the optimization of search processes or form submission.
- Excluded studies that are only focused on accessibility for a specific group, for example, blind users.
- Papers that focus on the software development process of applications for expert analysis.
- Work in progress that describe the data gathering process (usually web logs), but are not applied to a specific case.
- Complimentary tools proposed for the usability testing process (not fully described methods)

2.4 Data Extraction

The search was performed on December 11th, 2017. 239 papers were recovered. After applying the inclusion and exclusion criteria, and removing duplicates, the final count of evaluated studies is 65. The following table shows a summary of the results:

Table 1. Summary of search results.

Database name	Search Results	Duplicated Papers	Relevant papers
EBSCO	46	2	20
Web of Science	32	1	13
IEEE	161	1	32
Total	239	4	65

Table 2. List of the reviewed studies.

ID	Author	Title
1	M. H. N. M. Nasir; N. H. Hassan; M. K. M. Nor	Participatory User Centered Design Techniques for a Web Information System for Stroke
2	Adepoju, SA; Shehu, IS	Usability Evaluation of Academic Websites Using Automated Tools
3	Hinchliffe, A; Mummery, WK	Applying usability testing techniques to improve a health promotion website
4	Erickson, William; Trerise, Sharon; Lee, Camille; VanLooy, Sara; Knowlton, Samuel; Bruyère, Susanne.	The Accessibility and Usability of College Websites: Is your Website Presenting Barriers to Potential Students?
5	H. M. Grady	Web site design: a case study in usability testing using paper prototypes
6	Kanayama, T; Ogasawara, H; Kimijima, H; Kontio, J; Conradi, R	Quality control techniques for constructing attractive corporate websites: Usability in relation to the popularity ranking of websites
7	E. Olmsted-Hawala	Card Sorting, Information Architecture And Usability: Adding in Our Users' Perspective to Re-Design the Census Bureau Web Site
8	Jeong, Wooseob; Han, Hye Jung.	Usability study on newspaper mobile websites.
9	D. Alonso-Ríos; I. Luis-Vázquez; E. Mosqueira-Rey; V. Moret-Bonillo; B. B. del Río	An HTML analyzer for the study of web usability
10	Wan Fatimah Wan Ahmad; S. Sulaiman; Farah Syahidah Johari	Usability Management System (USEMATE): A web-based automated system for managing usability testing systematically
11	Saremi, HQ; Montazer, GA; Ardil, C	Web Usability: A Fuzzy Approach to the Navigation Structure Enhancement in a Website System, Case of Iranian Civil Aviation Organization Website

ID	Author	Title
12	Danielson, Carla Kmett; McCauley, Jenna L.; Gros, Kirstin Stauffacher; Jones, Andrea M.; Barr, Simone C.; Borkman, April L.; Bryant, Brittany G.; Ruggiero, Kenneth J. Health	SiHLEWeb.com: Development and usability testing of an evidence-based HIV prevention website for female African-American adolescents.
13	Herendy, C; Godart, C; Gronau, N; Sharma, S; Canals, G	How to Research People's First Impressions of Websites? Eye-Tracking as a Usability Inspection Method and Online Focus Group Research
14	P. Weichbroth; K. Redlarski; I. Garnik	Eye-tracking web usability research
15	Cappel, James J.; Zhenyu Huang.	A USABILITY ANALYSIS OF COMPANY WEBSITES.
ID	Author	Title
16	Georgiakakis, P; Retalis, S; Psaromiligkos, Y; Papadimitriou, G; Jacko, JA	DEPTH TOOLKIT: A web-based tool for designing and executing usability evaluations of e-sites based on design patterns
17	T. Conte; J. Massolar; E. Mendes; G. H. Travassos	Web usability inspection technique based on design perspectives
18	N. Borovina; D. Bošković; J. Dizdarević; K. Bulja; A. Salihbegović	Heuristic based evaluation of Mobile Services web portal usability
19	A. Sutcliffe	Assessing the reliability of heuristic evaluation for Web site attractiveness and usability
20	D. Davis; S. Jiang	Usability evaluation of web-based interfaces for Type2 Diabetes Mellitus
21	T. Conte; V. Vaz; J. Massolar; E. Mendes; G. H. Travassos	Improving a Web Usability Inspection Technique Using Qualitative and Quantitative Data from an Observational Study
22	Alotaibi, MB; Latifi, S	Assessing the Usability of University Websites in Saudi Arabia: A Heuristic Evaluation Approach
23	Torrente, MCS; Prieto, ABM; Gutierrez, DA; de Sagastegui, MEA	Sirius: A heuristic-based framework for measuring web usability adapted to the type of website
24	A. Paula Afonso; J. Reis Lima; M. Perez Cota	Assessing the usability of Web interfaces
25	D. Zimmerman; M. Slater; P. Kendall	Risk communication and usability case study: implications for Web site design
26	A. Al-Wabil; H. Al-Khalifa	A framework for integrating usability evaluations methods: The Mawhiba web portal case study

ID	Author	Title
27	A. P. Afonso; J. R. Lima; M. P. Cota	A heuristic evaluation of usability of Web interfaces
28	A. P. Afonso; M. J. Angélico; J. R. Lima; M. P. Cota	UsaWeb. A model for usability evaluation web interfaces
29	N. B. N. Rozali; M. Y. B. Said	Usability testing on government agencies web portal: A study on Ministry of Education Malaysia (MOE) web portal
30	Johnson, Melissa A.; Norris Martin, Kelly.	When Navigation Trumps Visual Dynamism: Hospital Website Usability and Credibility.
31	Nyman, Samuel R.; Yardley, Lucy.	Usability and acceptability of a website that provides tailored advice on falls prevention activities for older people.
32	Margolin, Jonathan; Miller, Shazia Rafiullah; Rosenbaum, James E.	The Community College Website as Virtual Advisor: A Usability Study.
33	Isa, WARWM; Yusoff, MM; Nordin, DAA; Berry, MW; Mohamed, AH; Wah, YB	Evaluating the Usability of Homestay Websites in Malaysia Using Automated Tools
34	Peute, LW; Knijnenburg, SL; Kremer, LC; Jaspers, MWM	A Concise and Practical Framework for the Development and Usability Evaluation of Patient Information Websites
35	Aizpurua, Amaia; Harper, Simon; Vigo, Markel.	Exploring the relationship between web accessibility and user experience.
36	L. Rivero; T. Conte	Using an Empirical Study to Evaluate the Feasibility of a New Usability Inspection Technique for Paper Based Prototypes of Web Applications
37	Tolliver, Robert L.; Carter, David S.; Chapman, Suzanne E.; Edwards, Phillip M.; Fisher, Jeanie E.; Haines, Annette L.; Krolikowski, Lana E.; Price, Rebecca M.	Website redesign and testing with a usability consultant: lessons learned.
38	O'Brien, Heather L.; Lebow, Mahria.	Mixed-methods approach to measuring user experience in online news interactions.
39	A. P. Afonso; J. R. Lima; M. P. Cota	Usability assessment of web interfaces: User Testing
40	P. Fernandes; T. Conte; B. Bonif'cio	WE-QT: A Web Usability Inspection Technique to Support Novice Inspectors
41	U. K. Yusof; L. K. Khaw; H. Y. Ch'ng; B. J. Neow	Balancing between usability and aesthetics of Web design

ID	Author	Title
42	Lepkowska-White, Elzbieta; Imboden, Kate.	Effective Design for Usability and Interaction: The Case of Art Museum Websites
43	Tisinger, Russell; Stroud, Natalie; Meltzer, Kimberly; Mueller, Brett; Gans, Rachel.	Creating Political Websites: Balancing Complexity & Usability.
44	Law, Rob; Ngai, Cathy.	Usability of Travel Websites: A Case Study of the Perceptions of Hong Kong Travelers.
45	Sundeen, Todd; Vince Garland, Krista; Wienke, Wilfred.	Perceptions of Special Education Doctoral Websites: A Multiyear Investigation of Website Usability and Navigability.
46	Aranyi, Gabor; van Schaik, Paul.	Modeling User Experience With News Websites.
47	Seckler, Mirjam; Heinz, Silvia; Forde, Seamus; Tuch, Alexandre N.; Opwis, Klaus.	Trust and distrust on the web: User experiences and website characteristics.
48	bin Ahmad, MA; Iahad, NA	Websites Usability Instrument Validation Using Think-Aloud Method
49	Jian-Li Duan; Shu-Xia Liu	Application on web mining for web usability analysis
50	Venkatesh, Viswanath; Hoehle, Hartmut; Aljafari, Ruba.	A usability evaluation of the Obamacare website.
51	S. Khodambashi; Ø. Nytrø	Usability Evaluation of Published Clinical Guidelines on the Web: A Case Study
52	L. Triacca; A. Inversini; D. Bolchini	Evaluating Web usability with MiLE+
53	W. A. R. W. M. Isa; A. M. Lokman; E. S. A. Wahid; R. Sulaiman	Usability testing research framework: Case of Handicraft Web-Based System
54	A. Granic; I. Mitrovic; N. Marangunic	Usability evaluation of web portals
55	Zhao Huang; Benyoucef, Morad.	Usability and credibility of e-government websites.
56	Van Waes, L	Thinking aloud as a method for testing the usability of websites: The influence of task variation on the evaluation of hypertext
57	E. L. Olmsted-Hawala; E. D. Murphy; S. Hawala; K. T. Ashenfelter	Think-aloud protocols: Analyzing three different think-aloud protocols with counts of verbalized frustrations in a usability study of an information-rich Web site
58	Hatter, Alicia; Howard, Tharon.	Intentional Bias: An Empirical Study of Interpellative User Experiences on University Donor Websites.

ID	Author	Title
59	Nicolson, DJ; Knapp, P; Gardner, P; Raynor, DK	Combining Concurrent and Sequential Methods to Examine the Usability and Readability of Websites With Information About Medicines
60	Cunningham, Anna; Johnson, Frances.	Exploring trust in online health information: a study of user experiences of patients.co.uk.
61	M. Swaak; M. de Jong; P. de Vries	Effects of information usefulness, visual attractiveness, and usability on web visitors' trust and behavioral intentions
62	T. Lau	Toward a user-centered web design: lessons learned from user feedback
63	R. Geng; J. Tian	Improving Web Navigation Usability by Comparing Actual and Anticipated Usage
64	Chun-hung Li; Chui-chun Kit	Web structure mining for usability analysis
65	N. Harrati; I. Bouchrika; A. Tari; A. Ladjailia	Automating the evaluation of usability remotely for web applications via a model-based approach

2.5 Synthesis Strategy

The studies were grouped following the following criteria:
1st research question: Method and tools

- Method: Identifies the methodology approach selected for the study. Values are: User testing, Expert evaluation, Automated, Data mining. A paper can have more than one category
- Tools: Identifies the tools that were used for the research: card sorting, questionnaire, focus group, observation or the think aloud protocol.

2nd research question: Aspects of evaluation

- Criteria: Specific criteria applied in the study. Values are: Accessibility, Usability, User experience, Content, Aesthetics, Information architecture, trust, emotion.

3rd research question: Stage in the development process.

- Development phase: Stage in the software development process in which the research was applied.

4th research question: Efficiency and efficacy

- Satisfaction obtained from the proposed method application.
- Cost to apply the proposed research methodology in terms of people, time and money: low, medium, high.
- Level of technical expertise required from the evaluator: low, medium, high.

Additionally, we observed the number of evaluated sites: Some approaches are at the level of proposal, which means they have been tested with very few websites.

3 Results

3.1 P1: Methods and Tools

With regard to the method used, the results show that 47% of the selected studies used some form of user testing, and 27% used expert evaluation. 12% studies used a combination of user testing and expert evaluation, and 8% used data mining techniques that included content mining and pattern identification in links or content. The remaining 6% other methods that include automated tools focused in the evaluation of usability and accessibility (usually using a tool that implements the latest version of the Web Content Accessibility Guidelines - WCAG specification [13] that requires the input of the website url to perform a compliance analysis), analytics to identify navigation patterns or modifications in the software development process to incorporate tasks that prevent known usability issues. Remote testing was applied in some studies that implemented user testing to reduce costs in time and subject availability.

Table 3. Methods used in reviewed studies.

Method	Times used	Studies
User testing	29	[7], [8], [9], [10], [11], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [63], [64]
Expert evaluation	15	[4], [5], [6], [20], [21], [22], [23], [24], [25], [26], [27], [28], [46], [47], [48], [49]
User testing, expert evaluation	9	[12], [13], [41], [42], [43], [44], [45], [65]
Data mining	3	[15], [17], [18]
Automated	2	[2], [14]
User testing, self-report	1	[50]
Analytics	1	[1]
Automated, data mining	1	[3]
Automated, user testing	1	[15]
Data mining, user testing	1	[19]
Guidelines	1	[29]
Software Development flow modification	1	[30]

With regard to the tools used, the results show that the most frequently used tool is questionnaires, which are used as a guide to give structure to the user testing process while applying interviews, focus groups and the think aloud method. Questionnaires can also be directly applied to the user as a data collection tool by itself (System Usability Scale - SUS)[14]. Heuristic evaluation was used as the tool of choice for expert evaluation. The most frequently used specification was the heuristics set proposed by Jacob Nielsen [14]. Other specifications used for the expert evaluation process were the Microsoft Usability Guidelines [15], custom measures derived from other knowledge field such as psychology (psychometric scales) or a combination and adaptation of an existing heuristics set with new measures proposed by the researcher.

Interviews were used as a complimentary tool, mostly to obtain information of aspects of the user experience that were difficult to measure because of their subjective nature (emotions, attitudes or trust), and also to explain user behavior in specific contexts.

The think aloud method was used in combination with direct observation and task completion. Focus groups were mostly used to discuss expectations and perceptions. Card sorting was used specifically to identify improvements in the navigation of the website, by proposing an optimized information architecture from existing terms. Web logs, data mining and clickstream analytics were used to identify patterns in user navigation. Eye tracking was used to examine fixations in existing visual designs. Benchmarking was used as a tool in the early planning moments to compare existing websites in an specific industry with the goal of defining usability requirements for the implementation or critical content. Paper and digital prototypes were used as a tool in both early planning and development phases. Other tools as webmaster emails, word prompts and psychometric scales were used scarcely as a complimentary to existing methods. One study proposed software to improve the efficiency of the usability process by means of providing an application that contains all the information generated during the evaluation process.

Table 4. Tools used in the reviewed studies

Tool	Times used	Studies
Analytics	1	[38]
Benchmarking	2	[5]. [6]
Card sorting	4	[1], [7], [26], [37]
Custom measures	1	[8]
Custom software	2	[9], [10]
Eye tracking	3	[13], [14], [26]
Focus group	6	[1], [13], [26], [28], [34], [62]
Guideline	2	[15], [16]
Heuristic evaluation	16	[16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [34], [52], [54]
Interview	14	[1], [3], [28], [29], [30], [31], [32], [35], [37], [39], [48], [51], [54], [60]
Link checker	3	[2], [4], [33]
Observation	7	[3], [6], [29], [35], [51], [55], [59]
Psychometric scale	1	[38]
Questionnaire	25	[3], [6], [24], [25], [28], [29], [30], [31], [35], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [53], [54], [55], [61], [64]
Survey	6	[26], [32], [47], [50], [51], [62]
Task completion	12	[4], [25], [26], [30], [48], [51], [52], [53], [54], [55], [63], [65]
Think aloud method	13	[14], [25], [26], [31], [32], [34], [48], [56], [57], [58], [59], [60], [61]
Web log	5	[3], [11], [63], [64], [65]

Tool	Times used	Studies
Webmaster emails	1	[62]
Word prompt	1	[35]
Prototype	7	[5], [29], [34], [34], [36], [37], [62]

3.2 P2: Evaluated aspects and criteria

With regard to the criteria used for the evaluation, the most commonly evaluated croteroa are usability, content, aesthetics and information architecture (navigation). User experience is mentioned as a research goal but it's always decomposed in more specific aspects, usually the above mentioned content, aesthetics and information architecture, or custom measures proposed by the researcher conditioned to the website's industry. Task completion is also frequently measured; however, it's limited to tasks related to information finding using the proposed navigation or visual interface. Subjective criteria included in several studies are trust, emotion, engagement and persuasion. In some cases, industry specific adaptations are made to the evaluation criteria to allow focus on specific tasks related to the website's communication goals or user profiles.

Table 5. Criteria used to evaluate user experience and/or usability in websites.

Criteria	Times used	Studies
Performance	7	[9], [29], [33], [33], [52], [53], [65]
Emotion and engagement	2	[35], [38]
Persuasion	1	[58]
Popularity	1	[6]
Trust	5	[30], [47], [55], [59], [60]
Accessibility	5	[2], [4], [9], [23], [35]
Aesthetics	18	[3], [8], [12], [19], [22], [23], [24], [29], [30], [41], [43], [45], [47], [52], [58], [60], [61], [62]
Attitude	2	[13], [31]
Broken links	2	[9], [33]
Content	22	[1], [6], [8], [11], [12], [15], [25], [30], [32], [38], [42], [44], [45], [46], [47], [50], [52], [55], [58], [59], [60], [61]
Information Architecture	16	[1], [3], [7], [8], [11], [12], [22], [32], [37], [42], [43], [44], [45], [46], [52], [64]
Interactivity	1	[43]

Criteria	Times used	Studies
Usability	57	[1], [3], [4], [5], [6], [7], [9], [10], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [48], [49], [50], [51], [53], [54], [55], [56], [57], [58], [59], [61], [62], [63], [64], [65]
User experience	7	[19], [25], [39], [47], [54], [59], [62]

3.3 P3: Development phase

With regard to the development phase, 82% of the selected studies were conducted when the evaluated website(s) is in the final stages of implementation or already published, 6% of the studies were made in the planning/requirements stage, and 8% in the graphic design stage. Only one study proposed an iterative methodology during the development phase. These proportions can be explained because the evaluation of the complete user experience of an information-driven website requires the evaluation of the published information, the visual design and the functioning navigation as a complete system. Since these aspects are not fully formed while the website is in process of being coded, studies that require an evaluation in the early phases of a web development project must resort to methods that evaluate existing websites in the same industry (benchmarking) or simulate the final product (prototypes). These methods do not guarantee that new user experience problems can appear in the finished product. Since the user testing process is expensive in time and resources it is logical that most studies are executed when the implementation is already complete, when the evaluation will yield the most complete set of information.

Table 6. Project phases in which studies are conducted

Development phase	Times used	Studies
Completed	52	[2], [4], [8], [9], [10], [11], [13], [14], [15], [16], [17], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [30], [31], [32], [33], [35], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [57], [58], [59], [60], [61], [63], [64], [65]
Design	5	[3], [5], [7], [18], [62]
Coding	1	[12]
Not specified	1	[56]
Planning	4	[1], [34], [36], [37]
Planning, Completed	2	[6], [29]

3.4 P4: Efficacy and Efficiency

Since the studies do not share the same evaluation criteria for the user experience, it is not possible to give an exact, shared measure of efficacy and efficiency of the methods and tools by a common quantitative standard. The point of reference used for this review was the perceived efficiency and efficacy from the point of view of each researcher relative to their own experience, expressed in the conclusions and observations of the case studies. Studies were classified manually with this consideration.

The researchers mentioned that the most effective methods are expert evaluation, user testing, or a combination of both. Expert evaluation is considered below user testing because researchers are aware that it can generate blind spots caused by the expert's familiarity with the website's topics and structure. Data mining provides high results and low cost but does not explain why the user acted in a specific way, and requires a high level of technical expertise.

With regard to the efficiency of the selected methods, the most efficient is expert evaluation, followed by data mining and automated tools. User testing is the most expensive method. Modifications to reduce costs in application include the use of remote testing tools such as online surveys, and limitation of the collected data to predefined values, however this approaches tend to impact negatively the quality of the knowledge generated by the methodology.

Table 7. Satisfaction and cost per methodology.

	Perceived satisfaction			Perceived cost		
Evaluation methods	Low	Medium	High	Low	Medium	High
Analytics	0	1	0	0	0	1
Automated	0	1	1	2	0	0
Automated, data mining	0	0	1	1	0	0
Automated, user testing	0	0	1	1	0	0
Data mining	0	1	2	2	0	1
Data mining, user testing	0	1	0	1	0	0
Expert evaluation	0	7	9	11	3	2
Guidelines	0	0	1	0	0	1
Self-report, user testing	0	0	1	0	0	1
Software Development flow modification	0	0	1	1	0	0
User testing	0	10	19	5	12	12
User testing, expert evaluation	0	2	6	2	4	2

4 Conclusions and future work

This paper presents a systematic review conducted to identify the methodology, tools and criteria used to evaluate the user experience in information driven websites, and the efficacy and efficiency reported by the researchers after the application of the selected methodology. Papers that evaluated usability were also included because they included references to user experience evaluation. 65 studies were selected from 239. Empirical evidence was extracted from these studies, coded and aggregated.

We identified that the dominant methodologies are user testing and expert evaluation because of the quality of the obtained information. New methods proposed by researchers include data mining and automated tools to improve the data collection and processing process. Evaluation criteria can be general (compatible with all types of websites) or adapted according to the industry's communication goals. After usability, content, information architecture, aesthetics and task completion are the most frequently used criteria for the evaluation. Balance between usability and aesthetics is seen as a compromise, especially since website owners require customized interactivity to differentiate themselves from other websites. Proposed methods and tools required that the evaluator is already familiar with user experience/usability and has some degree of technical competence (background in information technology, statistics or data science); however, tasks such as questionnaire application can be delegated to evaluators with less experience.

Most studies were conducted over already published websites because navigation, content and visual design are aspects that need to be included for a complete user experience evaluation. This also means that there is not an established methodology for user experience evaluation during the software development process of an information divan website. This does not imply that companies do not conduct this type of research in their projects, only that this type of knowledge is not registered in academic databases.

Further research can be developed in the following topics:

- Differences in the user experience from recurring users and new users, since the information they would be interested in, and the expectations of the website could differ.
- Usability/user experience evaluation in websites developed with agile methodologies.
- Impact on user experience of pop ups windows, and areas reserved for display of different formats of advertising.
- Differences in user experience between users of mobile version websites compared to responsive interfaces.

References

1. Salam Abdallah, Bushra Jaleel (2015) Website Appeal: Development of an Assessment Tool and Evaluation Framework of E-Marketing, Journal of Theoretical & Applied Electronic Commerce Research. Sep2015, Vol. 10 Issue 3, p45-62. 18p.
2. S. R. Ali, A. Khan, M. M. F. Baig and A. Umer (2015) Implementation of Kano's model in web metrics for information driven websites - KDQI, 2015 International Conference on Information and Communication Technologies (ICICT), Karachi, pp. 1-6.
3. Do Young Kwon, Seung Ryul Jeong (2015) A Content Analysis for Website Usefulness Evaluation: Utilizing Text Mining Technique, Journal of Korean Society for Internet Information. Aug2015, Vol. 16 Issue 4, p71-81. 11p.
4. Jan Hartmann, Antonella De Angeli, Alistair Sutcliffe (2008) Framing the User Experience: Information Biases on Website Quality Judgement, CHI 2008 Proceedings Exploring Web Content, Florence, 2008. pp. 855-864.
5. Sharon Trerise, Camille Lee , Sara VanLooy , Samuel Knowlton & Susanne Bruyère (2013) The Accessibility and Usability of College Websites: Is your Website Presenting Barriers to Potential Students?, Journal Community College Journal of Research and Practice Volume 37, 2013 - Issue 11, 2013. pp. 864-876
6. Beldad, A., De Jong, M., Steehouder, M. (2010) How shall I trust the faceless and the intangible? A literature review on the antecedents of online trust, Computers in Human Behavior, Volume 26, Issue 5, 2010, pp. 857–869

7. Glen L. Urban, Cinda Amyx, Antonio Lorenzon (2009) Online Trust: State of the Art, New Frontiers, and Research Potential, Journal of Interactive Marketing 23 (2009), pp. 179–190.
8. ISO (2010) ISO 9241-210:2010 Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems.
9. Wilkie, LeAnn, Romance, Kara, Rosendale, Joseph (2012) Website Usability: Reasons Underlying Emotions Reported by Users, Insights to a Changing World Journal. 2012, Issue 2, p133-156. 24p.
10. S. Y. Chen, Z. F. Li, G. L. Chen (2014) Design and Implementation of an Open Source Content Management System, Applied Mechanics and Materials, Vols. 651-653, pp. 1821-1826.
11. Damiano Distante, Michele Risi, Giuseppe Scanniello (2014) Enhancing Navigability in Websites Built Using Web Content Management Systems, International Journal of Software Engineering & Knowledge Engineering. Vol. 24 Issue 3, p493-515. 23p.
12. B. Kitchenham (2007), Guidelines for Performing Systematic Literature Reviews in Software Engineering, Version 2.3, EBSE Technical Report, Keele University, UK.
13. Web Content Accessibility Guidelines 2.0, W3C World Wide Web Consortium Recommendation 11 December 2008 (http://www.w3.org/TR/200X/REC-WCAG20-20081211/, Latest version at http://www.w3.org/TR/WCAG20/)
14. Brooke, J. (1996). SUS: A 'quick and dirty' usability scale. In P. Jordan, B. Thomas, & B. Weerdmeester (Eds.), Usability evaluation in industry (pp. 189–194). London, UK: Taylor & Francis.
15. J. Nielsen (1994) Heuristic evaluation. In Usability Inspection Methods (Eds. J. Nielsen and R.L. Mack), NY.
16. Microsoft Usability Guidelines, https://msdn.microsoft.com/en-us/library/bb158578.aspx